Post-Implementation Review of Linux Rollout for Advanced Weather Interactive Processing System (AWIPS)

Commerce IT Review Board

DOC/NOAA/NWS

July 26, 2006

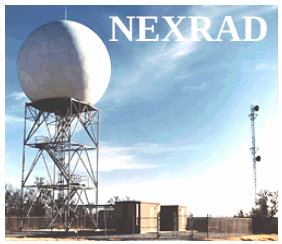
Agenda

- Introduction
- Basis for Investment
- Project Management
- Risk Management
- IT Security
- Architectural Compliance
- Administrative/Departmental Goals and Initiatives

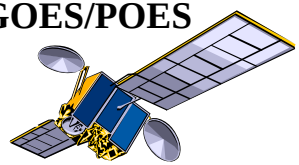
Introduction

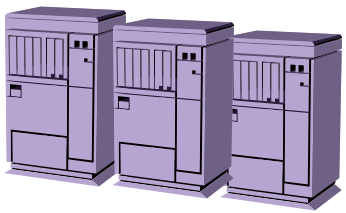
- Advanced Weather Interactive Processing System (AWIPS) integrates and displays all hydro-meteorological data at 137 National Weather Service (NWS) offices.
- AWIPS is the principal system used by meteorologists for producing forecasts and warnings.
- Linux Rollout allows AWIPS to accommodate the high volume, fine-scale data that are available from advanced satellite sensors, new radars, and other ground-based automated observing systems.

Introduction



GOES/POES





NCEP Models

AWIPS Communications

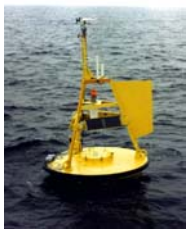
169 separate AWIPS systems at 137 geographical locations

AWIPS Workstations and Servers

~900 Workstations (total)
~1200 Servers (total)

- Warnings
- Watches
- Advisories
- Forecasts

Service provided to 3066 US Counties 24 hrs/day, 365 days/yr.



Buoys, River Gauges

Introduction

Briefed to the CITRB, 06/17/2003	Accomplished
• Phase I of the Linux Migration	✓ Completed 4Q03
• Phase I Satellite Broadcast Network (SBN) Enhancements	✓ Completed 3Q04
• Replace all AWIPS Workstations *	✓ Completed 2Q05
• Phase II SBN Enhancements *	✓ Completed 2Q05
• Replace all AWIPS Routers *	✓ Completed 3Q05
• Replace all AWIPS Firewalls *	✓ Completed 3Q05
• Deploy robust AWIPS Data Server Replacement *	✓ Completed 4Q05
• Award AWIPS Re-compete contract	✓ Completed 4Q05

* Note: Items marked with asterisks would not be completed without FY05 PAC budget increase

Introduction

Program Management Costs

(FY$M):	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12
CAPABILITY:								
Current Program	12.721	13.280	12.764	12.764	12.764	12.764	12.764	12.764
Current IT Resources	12.721	13.280	12.764	12.764	12.764	12.764	12.764	12.764
Program Adjustment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IT Program Adjustment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Program Total	**12.721**	**13.280**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**
Program IT Total	**12.721**	**13.280**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**
IT COMPONENTS:	**FY 05**	**FY 06**	**FY 07**	**FY 08**	**FY 09**	**FY 10**	**FY 11**	**FY 12**
Hardware	4.370	5.328	4.273	1.723	6.762	4.907	1.950	5.244
COTS Software	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
* Support Services (e.g. Software, Maint	7.882	7.401	5.556	6.239	4.939	5.392	5.982	6.427
Telecommunications	0.000	0.000	0.310	0.320	0.330	0.340	0.350	0.360
IT Security	0.000	0.000	1.392	3.749	0.000	1.392	3.749	0.000
IT Training	0.071	0.145	0.145	0.145	0.145	0.145	0.145	0.145
Common Services (ex. Help Desk)	0.398	0.406	1.088	0.588	0.588	0.588	0.588	0.588
IT Component Total	**12.721**	**13.280**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**	**12.764**

* Support Services includes S/W Re-Architecture, Contract Transition, Govt. FTE labor, and Support Contract costs

Introduction

- Lessons Learned
  - Non-proprietary Linux Operating System enabled competition and significant savings on hardware procurements
  - Open Source software is not a panacea –Vendor support for new technologies can be an issue
  - Communications with industry through Market Research, Industry Day, and Due Diligence sessions were key in large acquisition such as AWIPS

- Success Factors
  - Development of a good public/private partnership
  - Substantial Government effort into “Creating a competitive pool” of vendors and contractors for all acquisitions
  - The ability on the part of the Government team to embrace technological change
  - Performance based contracting –Tell industry what needs to be done, not how to do it

Basis for Investment

- The Weather and Water Forecast and Warning business is data- and computationally-intensive
- New Science improves the Forecast and Warning Process
  - The AWIPS workstations, servers, and communications provides the primary NWS forecaster interface for all NEXRAD Doppler Radar, NCEP, and Satellite Data
  - AWIPS Decision Assistance software tools and Interactive Forecast Preparation System (IFPS) result in better and faster forecaster decisions
- GPRA metrics are sensitive to AWIPS system performance
  - Tornado Warning Lead Time (13-15 min.)
  - Flash Flood Warning Lead Time (48-49 min.)
- NOAA Investments in AWIPS hardware have reduced system delays
  - Minutes of system delay can cost human life and result in the loss of property during weather and flooding events
- Continuous Technology Refresh (CTR) is crucial to our success
  - A static system cannot keep up with new science infusion, fine resolution datasets, or IT security requirements
  - More cost effective from a Total Cost of Ownership (TCO) perspective than a “Big Bang” system replacement

Basis for Investment

WFO/RFC Hardware Architecture

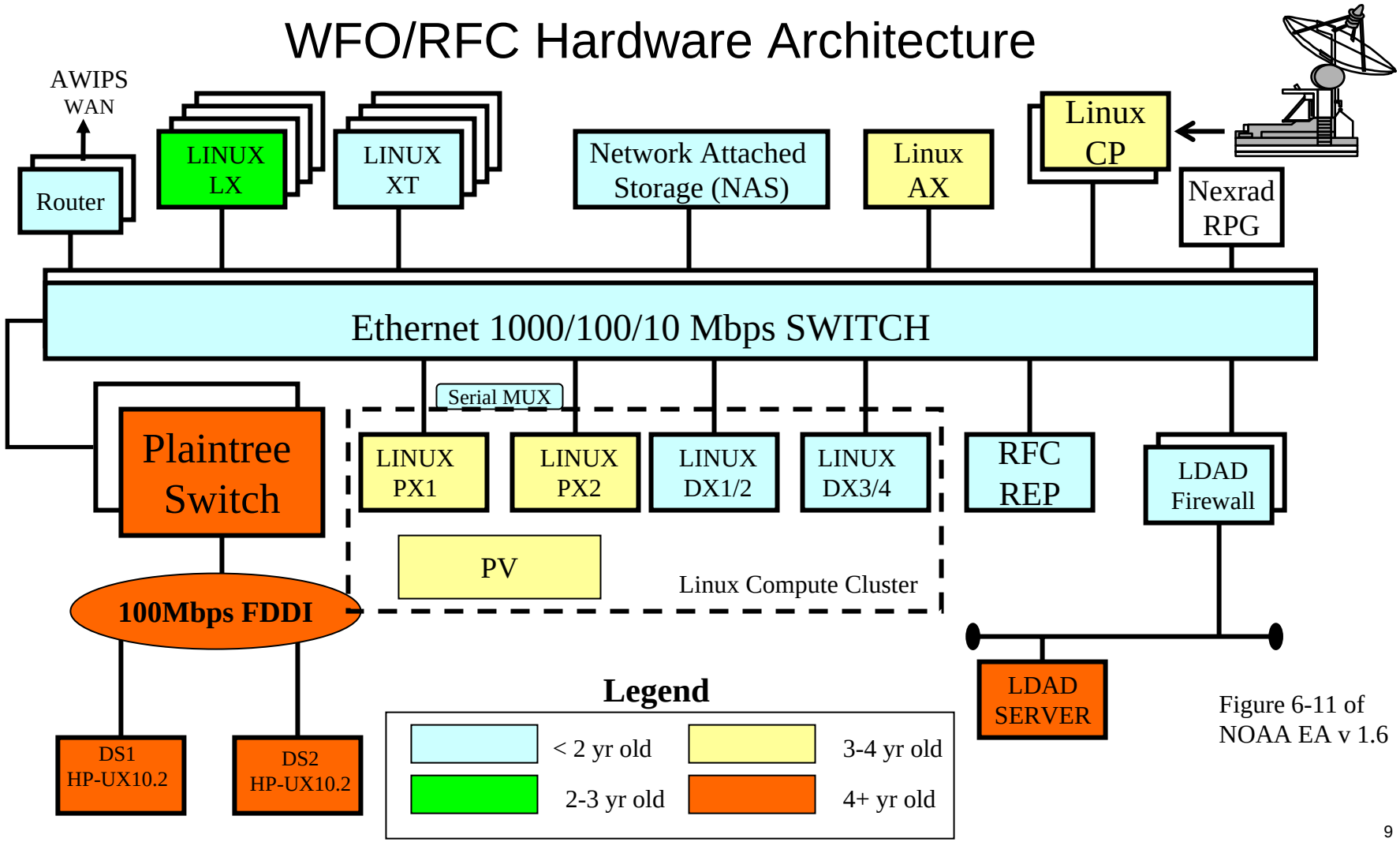


Figure 6-11 of NOAA EA v 1.6

Basis for Investment

NWS Warning Generation and Dissemination Process Model

Atmospheric Event

Forecaster Effectiveness

- Forecaster Training
- Observational and Model Data (Satellites, ASOS, NCEP, etc)
- Decision Assistance Tools

Forecaster

Performance Threshold (Nominal)

WSR-88D → Process & DB → Display → Generate Warning → WAN → Disseminate Warning → Warnings to Public & Media

AWIPS Workstation Performance Rating (WPR)

AWIPS Message Latency

Time line

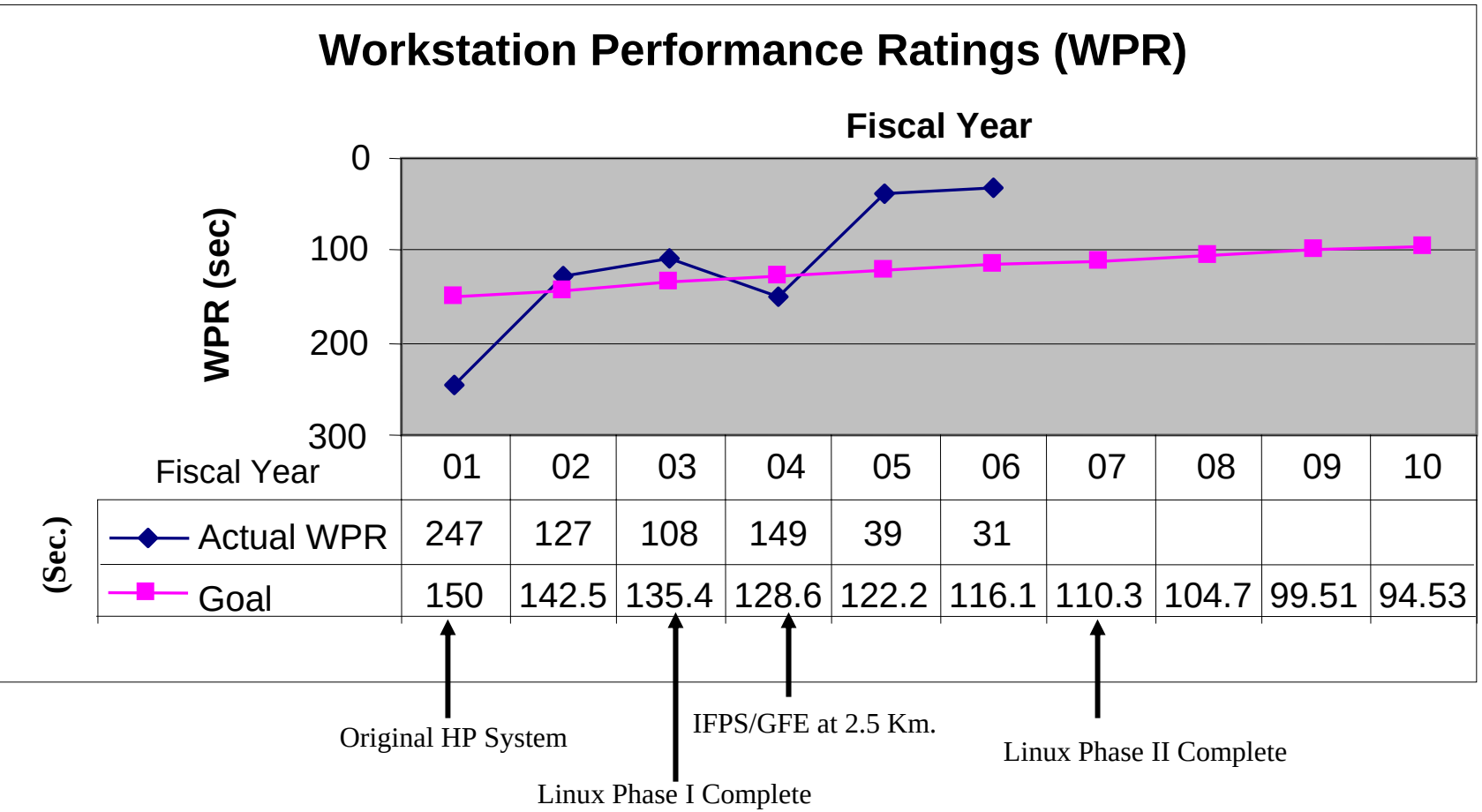
T=0 | T=4 min. | T=5 min. | T=5.5 min. | T=6 min. | T=6.5 min. | T=7 min.

Note: Delays shown here are notional.
Actual system delays at an operational site depend on many variables such as weather, time of day, etc.

Basis for Investment

Benchmark Performance

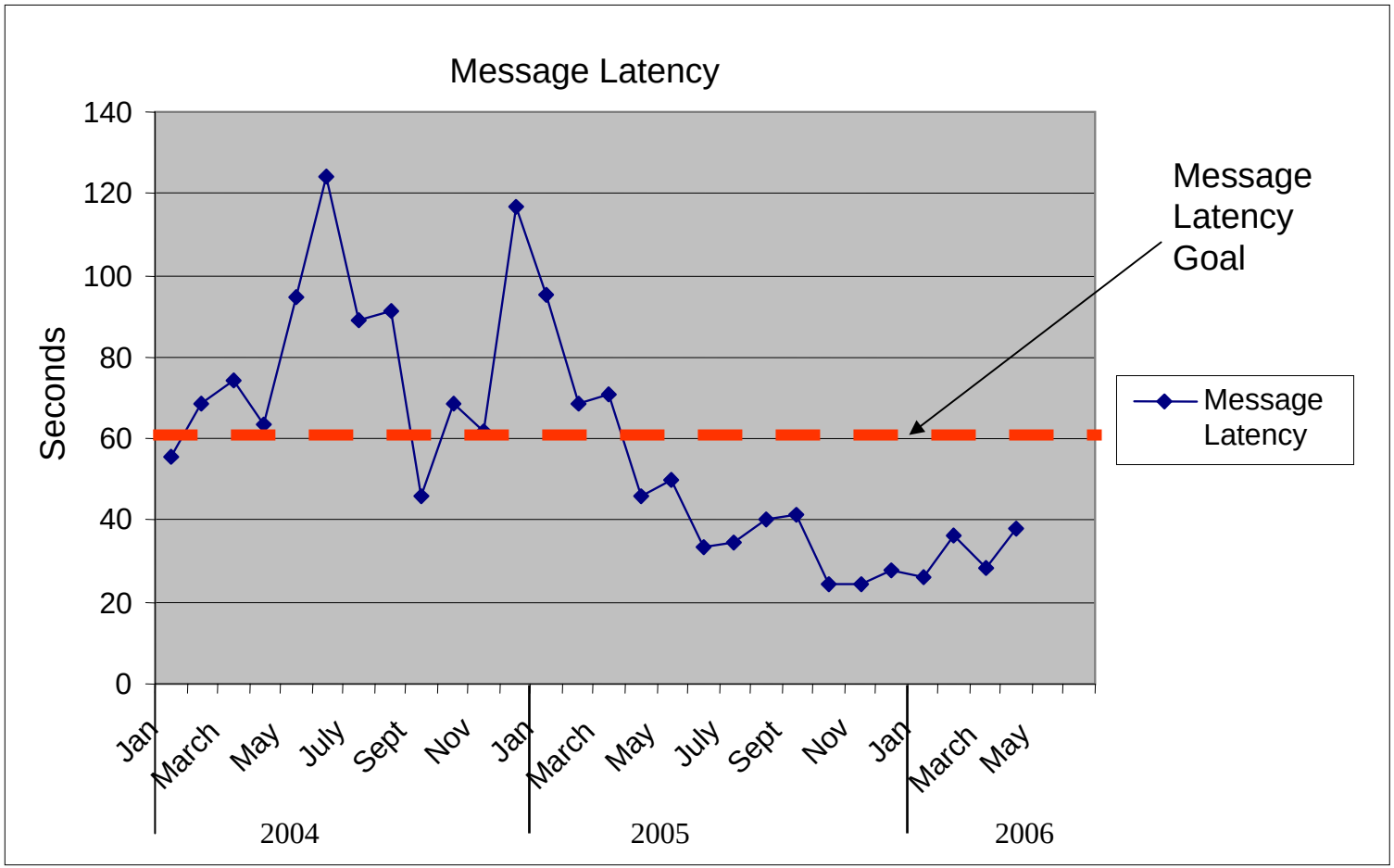
User Perceived System Performance, measured by Workstation Performance Rating Benchmark



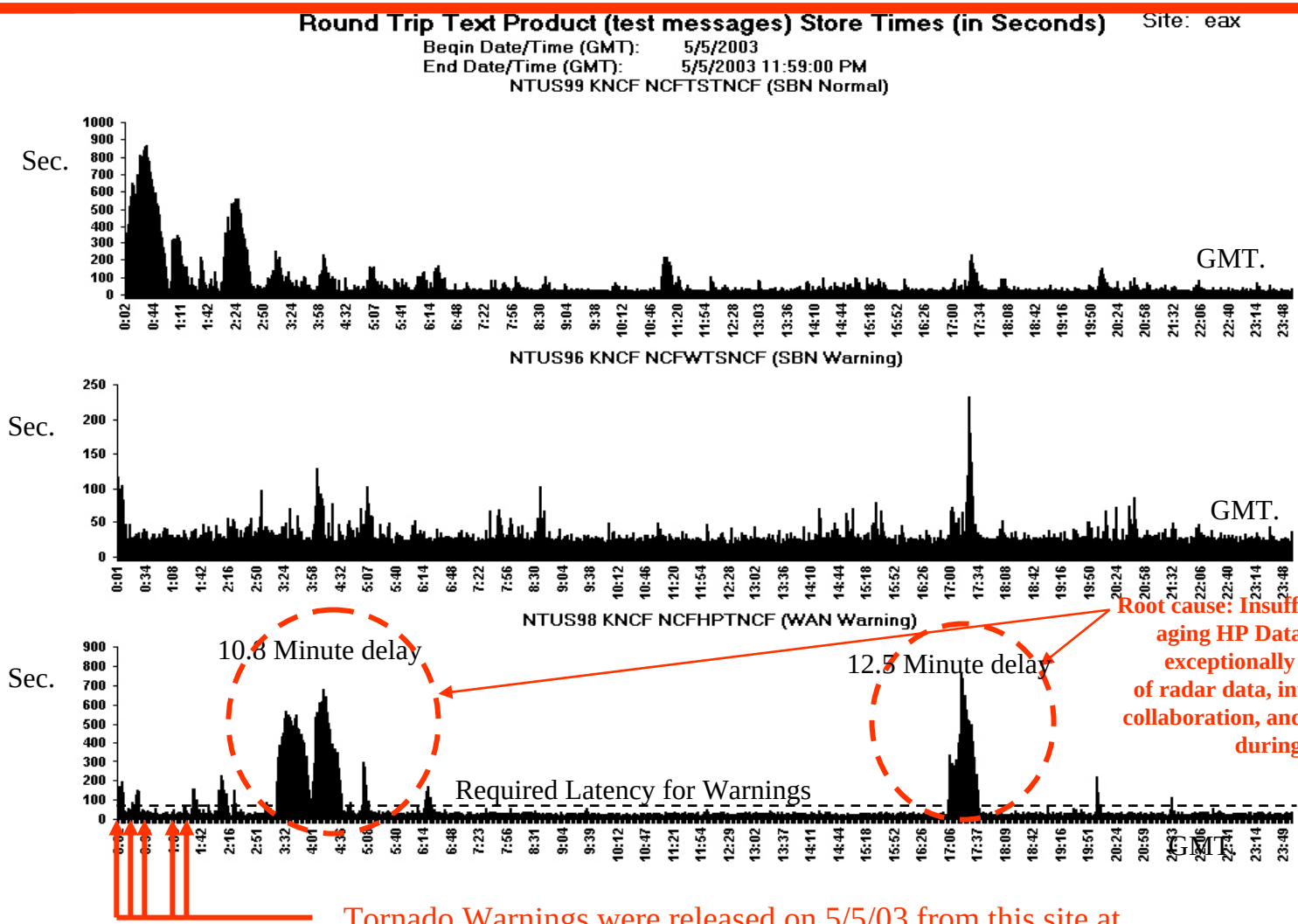
Basis for Investment

Trend in Overall AWIPS Message Latency, 2004-2006

Measured at all Hub sites, Averaged Monthly



Basis of Investment
AWIPS Message Delays at Kansas City WFO During May 4-10, 2003 Tornado Outbreak

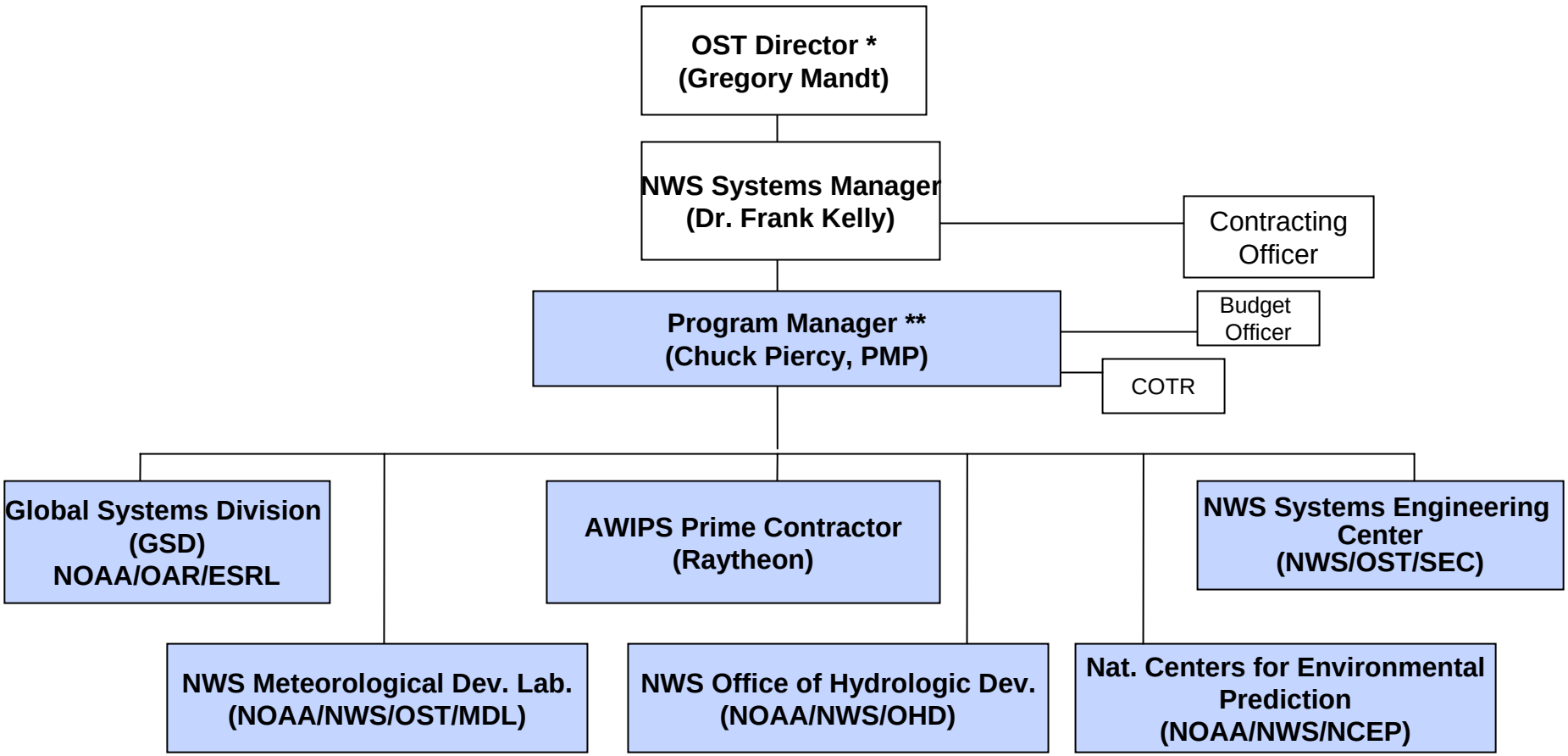


Basis for Investment

AWIPS Strategic Direction

Capacity Needed	**Technological Approach**
Processing Capacity	-Continue to port AWIPS software from HP-UX to Linux -Finish replacing aging HP equipment with “commodity” Intel-based equipment running Linux -Implement a 3-5 yr. Continuous Technology Refresh (CTR) cycle for all hardware components
Telecommunications Capacity	-Utilize data compression on existing data -Utilize Digital Video Broadcast- Satellite (DVB-S) and IP multicast -Combine four channels into a single 9.3 Mbps DVB-S channel -Key architectural technological component -**Phase III -Scale up to a full transponder (~40Mbps) if funded in FY09 -- (Needed to support NPOESS and GOES-R)**
Software Architecture	-Restructure the AWIPS software into a standard **Service Oriented Architecture (SOA)** components to make it easier to insert science and technology, while reducing O&M costs and complexity

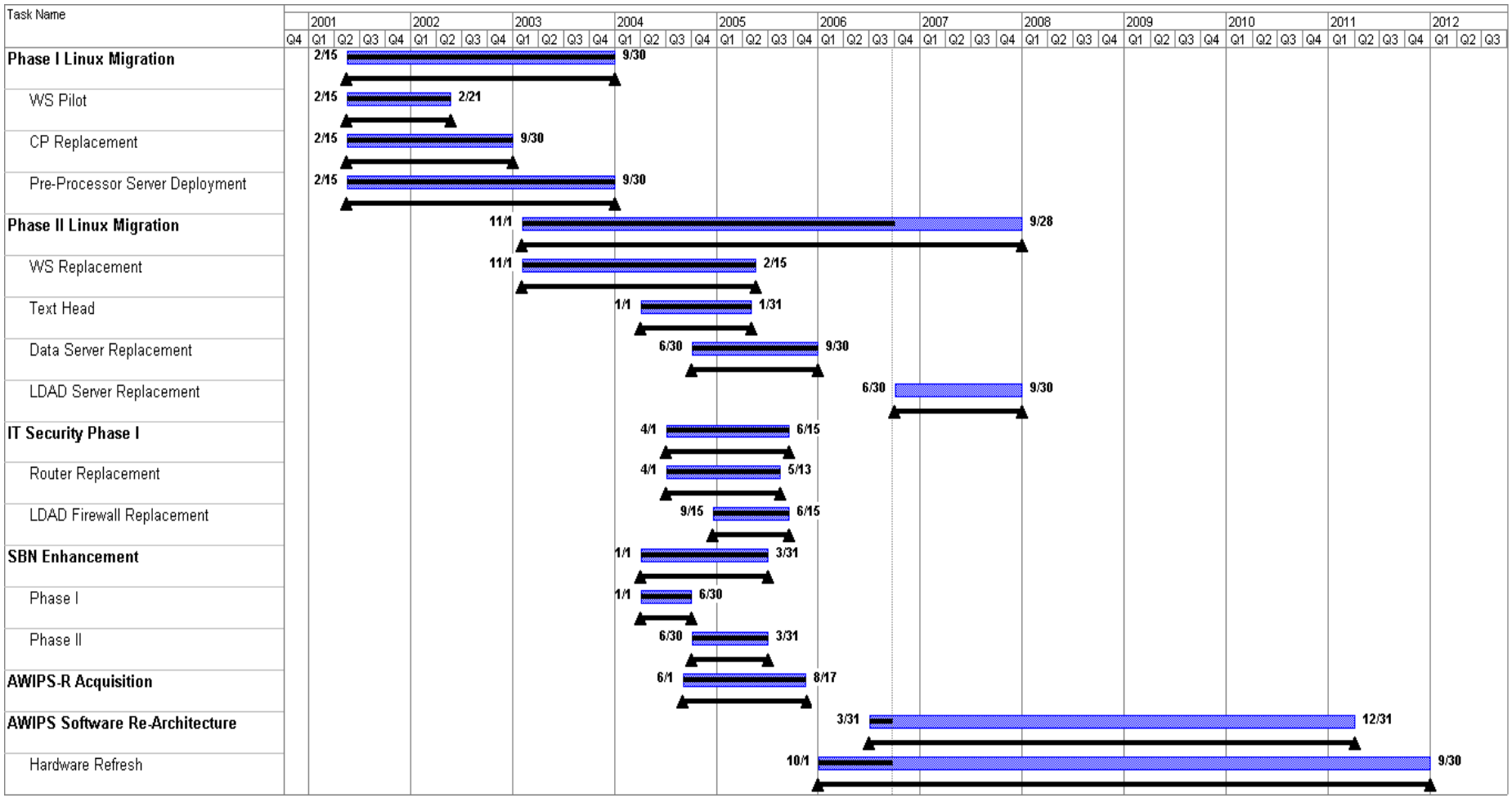
Program/Project Management



* OST is the NWS lead for system improvements for AWIPS, NEXRAD, and ASOS

** Certified PMI Project Management Professional (PMP), and member of the Project Management Institute

Project Management



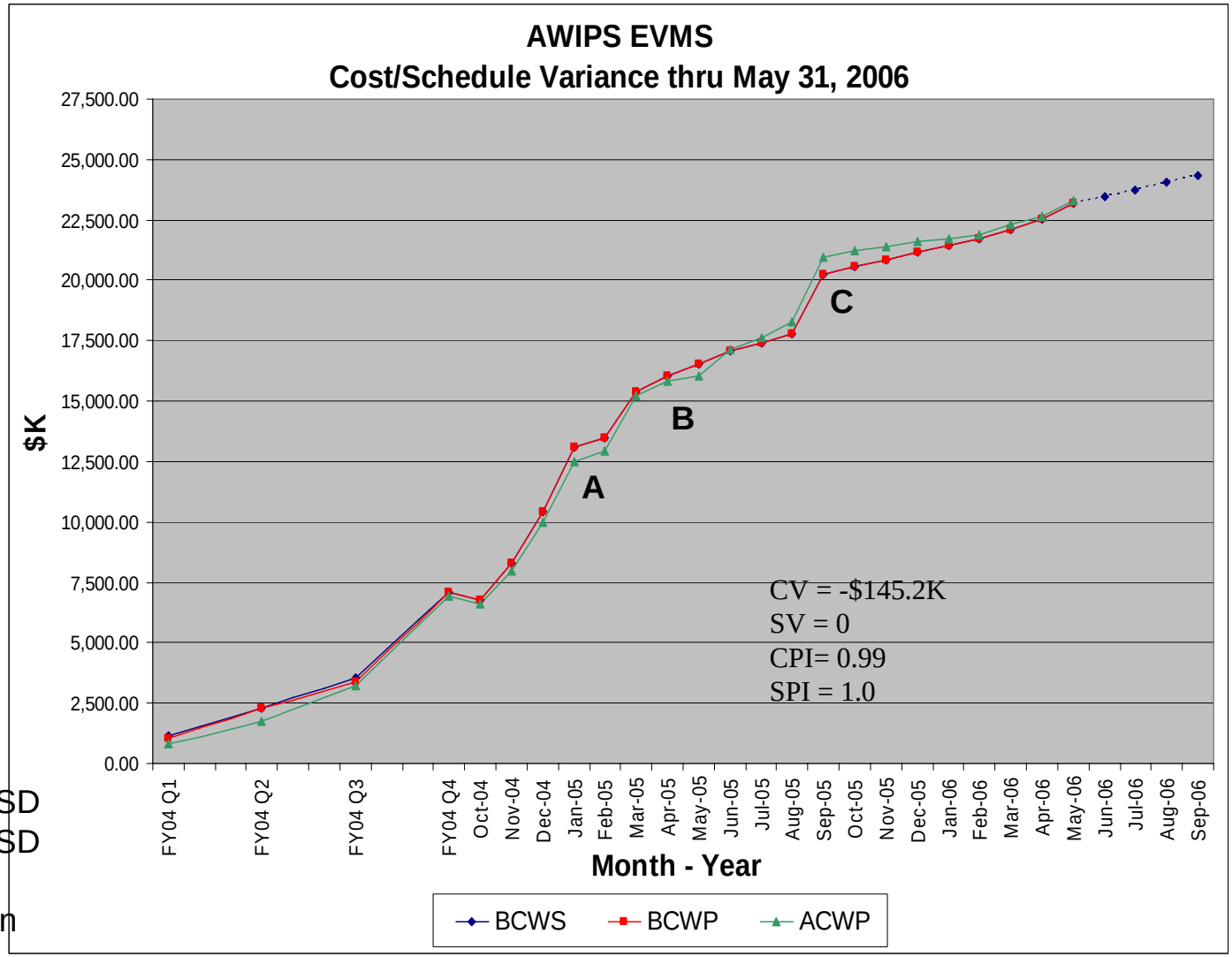
Task Baseline Progress

Project Management

New AWIPS Prime Contract

- AWIPS-recompete contract awarded to Raytheon Information Solutions (RIS) on August 17, 2005
  - Valued at about $330M
  - Firm Fixed Priced
  - Performance based with a Statement of Objectives (SOO)
- Quality Assurance Surveillance Plan (QASP)
  - Earned 57% of $115K available incentive pool in evaluation period one
- Includes options for:
  - Continuous Technology Refresh (CTR) hardware, software, & communications)
  - Software Maintenance and Support (SMS)

Project Management



Variances:
A: + Late obligations at GSD
B: + Late obligations at GSD and on NGIT CLIN 0227
C: - Due to Base Mitigation

Risk Management

- Risk Management Plan (RMP)
  - Qualitative risk assessment and prioritization
  - RMP requires each risk to be assigned a “Risk Owner” and to have a mitigation strategy assigned to it
- Risk Inventory
  - Dynamic –New risks can be identified at any time
  - Currently over 24 risks in risk inventory
  - Maintained in the Risk Assessment, Management, and Planning (RAMP) tool
  - RAMP outputs available online on access-controlled web portal
  - Risks are periodically reviewed at Partnership Integrated Product Team (PIPT) meetings

Risk Management

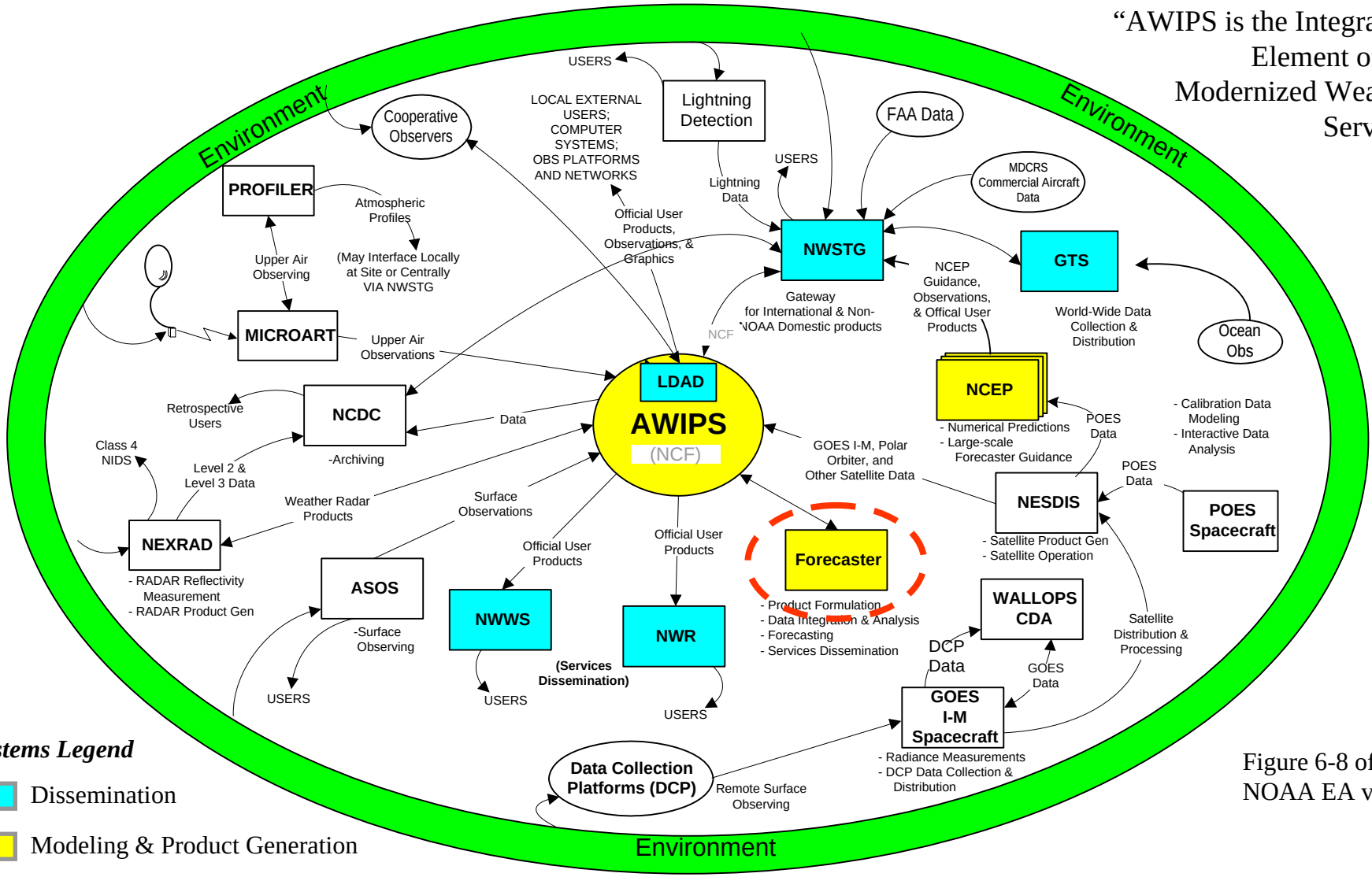
- Risk Management Plan (RMP)
- Risk Inventory
  - Dynamic – Currently over 24 risks
  - Maintained in Risk Assessment, Management, and Planning tool
  - Periodically reviewed at Partnership Integrated Product Team meetings
- Initial High-Impact Programmatic Risks:
  - Transition to new contractor (Raytheon)
    - Insufficient staff for Network Control Facility (Closed)
    - Ineffective transition to Satellite Broadcast Network (Closed)
    - Security breach by disgruntled contract employee (Closed)
    - Unacceptable implementation of Operational Build 6 (Closed)
  - O&M Risks
    - Unacceptable performance by Raytheon (Closed)
  - Technical/Operational
    - Service Outage due to HW refresh activities
    - Software Re-architecture fails to meet performance requirements

IT Security

- NOAA System ID: NOAA-8107
- Rigorous Network Security
  - Private IP Network with non-advertised routes
  - Strong investment in IT security refresh
  - Well defined and controlled system boundary
  - Centralized firewall management
- C&A Package signed by DAA 9/29/2005
- Meeting all POA&M milestones
- Security Control Testing by Booz-Allen Hamilton in 7/2005
  - Internal Pen Testing results consistent with periodic Harris scan testing
  - External Pen Testing had no findings
- COOP/CIP systems in place last tested 6/2006
  - Backup Master Ground Station (BMGS)
  - Backup Network Control Facility (BNCF)
- Strong SW/HW Configuration Management
- Looking at better ways to integrate security patching into Software Integration and Test (SwIT) and deployment processes

Enterprise Architecture

"AWIPS is the Integrating Element of the Modernized Weather Service"



Systems Legend

- Dissemination
- Modeling & Product Generation
- Observing

Figure 6-8 of NOAA EA v 1.6

* Note some systems perform multiple functions, e.g. LDAD disseminates information and receives observations

Architectural Compliance

- Collaboration on Achieving Enterprise Solutions
  - AWIPS is the integrating element of the Modernized Weather Service
  - AWIPS Uses Enterprise Red Hat Linux support contract
  - AWIPS Contract supports Climate, Weather and Water, Transportation, and Coastal and Ocean Resources
- Reuse of existing assets
  - HazCollect uses AWIPS for message handling and routing to dissemination systems
  - Shared use of NOAA-Net for Wide Area Network in progress
  - AWIPS provides NEXRAD visualization and data collection functions
  - AWIPS software used by other Government projects - RSA II, WES, FX-Net
- Usage of Standards
  - Design complies with NOAA and Federal Enterprise Architecture standards
  - Complies with statutory requirements
    - Information Quality (Section 515) & Accessibility (Section 508)
    - Government Paperwork Elimination Act (GPEA)
    - Computer Security Act/Government Information Security Act

Administration/Department Goals and Initiatives

- President's Management Agenda
  - Expanded E-Gov
    - Direct applicability to the Disaster Management e-Gov Initiative (Hazcollect)
    - AWIPS WAN is an important data source for NWS Web Farms that are accessible through **www.firstgov.gov**
  - Budget and Performance Integration
    - Investments tied to performance improvements
  - Competitive Sourcing: Functions best done by industry are outsourced
- DOC Goal One: Provide the information and tools to maximize U.S. competitiveness and enable economic growth for American industries, workers, and consumers
  - Linux Rollout has increased the mission effectiveness of the operational NWS
  - AWIPS is critical to the NWS mission of providing weather, water, and climate data to industry, as well as saving lives and property
  - Supports the transportation industry
  - Provides the necessary NOAAPort infrastructure for sustaining and improving Nation's public and private weather services

Administration/Department Goals and Initiatives

- DOC Goal Two: Foster Science and Technological Leadership
  - Early adopters of Linux workstation technology
- DOC Goal Three: Observe, protect, and manage the Earth's resources to promote environmental stewardship
  - Improve understanding and prediction of processes associated with the atmosphere and hydrosphere
  - Improve weather, water, and climate, warning and forecast services

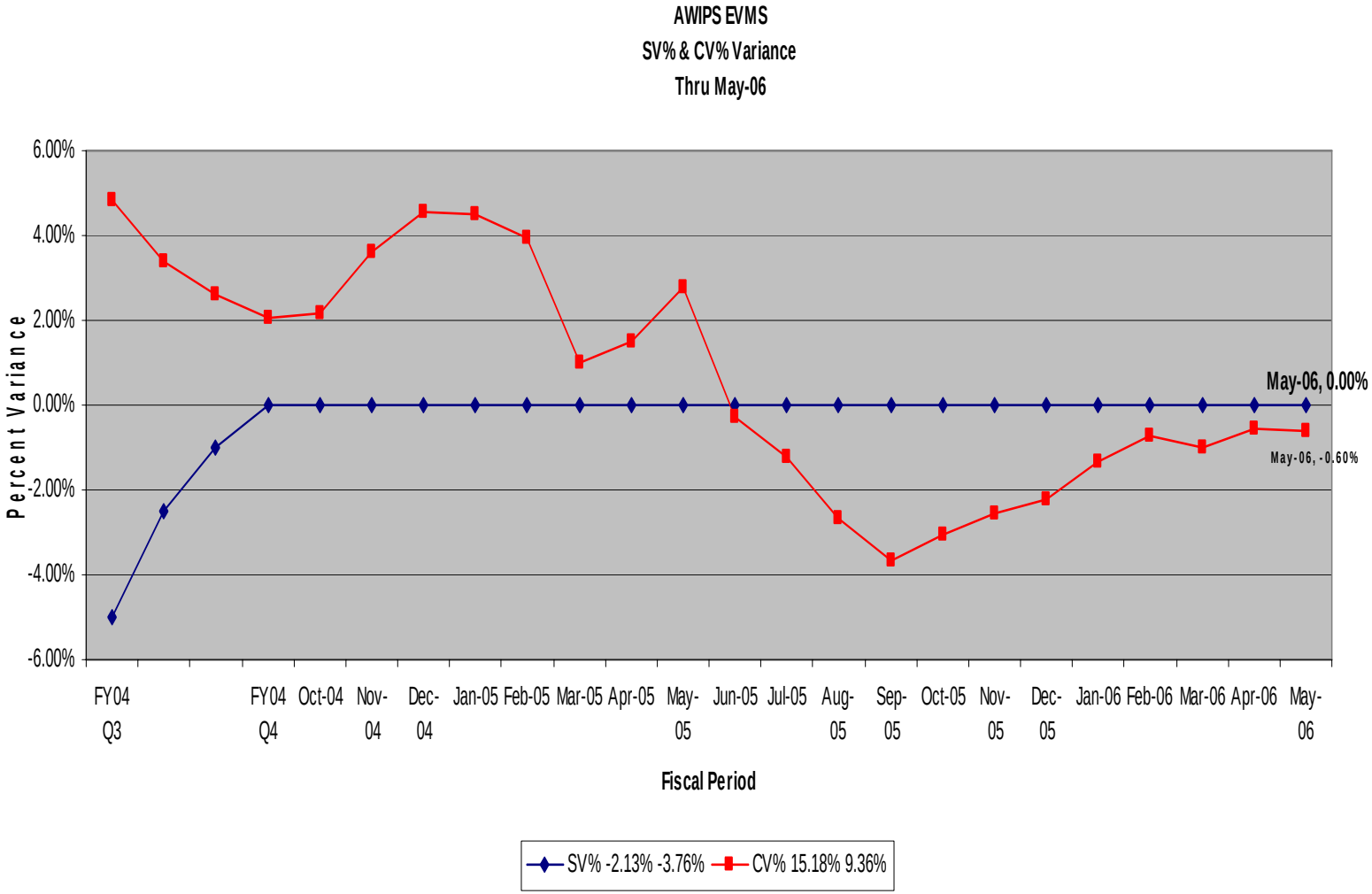
Backup

Summary

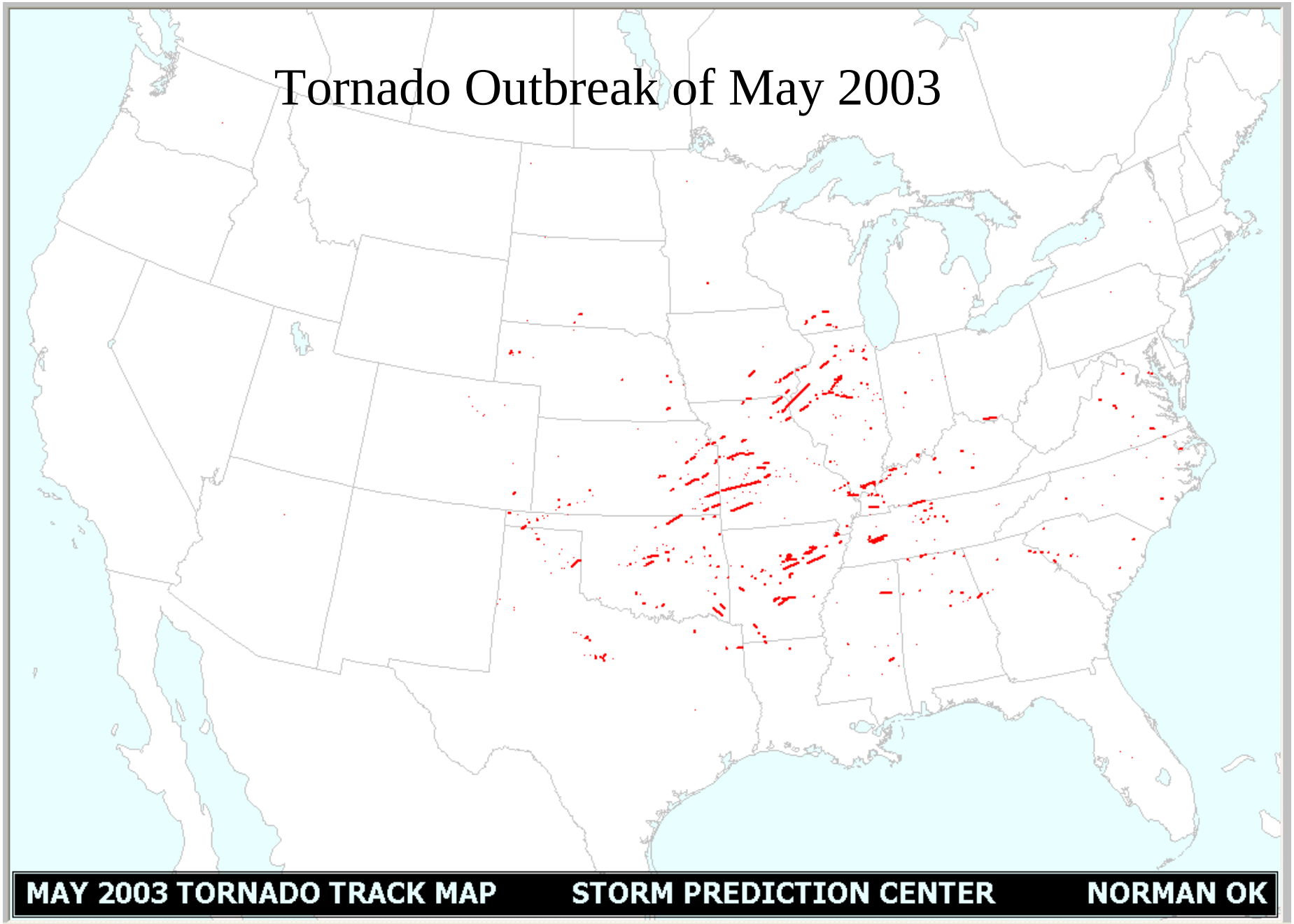
- AWIPS is a critical part of the Nation's infrastructure for sustaining the $4 Trillion weather sensitive economy* and for protecting lives and property from severe weather and water events
- AWIPS is carrying more data and providing more functionality than we ever envisioned when it was initially designed – Continuous Technology Refresh (CTR) has enabled us to keep it current to support our field forecasters and the public
- The Linux Rollout has greatly added needed processing power to AWIPS in a cost effective way
- The NWS has demonstrated the management and technical capability to keep AWIPS technologically current and functioning in its role as an integrating element in the NOAA Enterprise Architecture

* Source: Economic Statistics for NOAA fifth edition, dated April 2006, Office of the NOAA Chief Economist (http://www.economics.noaa.gov/)

Project Management



Tornado Outbreak of May 2003



* In the first week of May 2003 395 Tornados were identified in 19 states using AWIPS, 1090 tornado warnings, 2009 Severe thunderstorm warnings, and 683 flash flood warnings were issued using AWIPS.

Service to the Nation during the May 4-10 Tornado Outbreak

- 4,867 Warnings were issued using AWIPS during the week *
  - -1090 Tornado warnings issued using AWIPS
  - -2009 Severe Thunderstorm warnings issued using AWIPS
  - -683 Flash Flood warnings issued using AWIPS
  - -41 lives were lost
- -About 395 tornados were identified using AWIPS in 19 states during outbreak *
- -President declared four states as disaster areas (Missouri, Kansas, Tennessee, and Oklahoma)
- -Analysis and visualization tools in AWIPS enabled forecasters to prepare for severe weather two days in advance
- -Without AWIPS and NEXRAD the loss of life could have been as much as 20 times higher **

* Statistics from NWS Focus Newsletter, dated 5/12/03

** From Christian Science Monitor article dated 5/12/03 up to 20x higher, based on a comparison with April 1974 super tornado outbreak (148/330)

Comparison of May 4-10 Tornado Outbreak to the April 3-4 1974 "Super" Tornado Outbreak

Tornado Outbreak	Number of Tornados	People Injured	People Killed	Casualties/ Tornado
April 3-4 1974 (AL,OH,KY)	148	5,000	330	2.23
May 4-10 2003 (MO, KS, TN, OK)	395		41	0.104

Source: "Tornado Readiness Improving", The Christian Science Monitor, May 14, 2003

Basis for Investment

Schedule from 6/17/03 AWIPS CITRB Briefing

FY03	FY04	FY05	FY06	FY07	FY08	FY09
Linux Pre-Processor Workstation Replacement with Linux SBN Upgrade	Workstation Replacement with Linux SBN Upgrade	X-Terminal Replacement CP/LAN Refresh SBN Upgrade S/W Re-architecture *	Data Server Replacement with Informix Server (IX) * Router Replacement* SBN Upgrade S/W Re-architecture *	Workstation Refresh * LDAD Replacement * (60) SBN Upgrade* S/W Re-architecture *	Application Server Replacement * CP/LAN Refresh * LDAD Replacement (110) * SBN Upgrade * S/W Re-architecture *	LDAD Firewall Replacement * Informix Servers Refresh * CP/LAN Refresh * SBN Upgrade *

* Note: Items marked with asterisks will not be replaced or refreshed without FY05 initiative

Basis for Investment

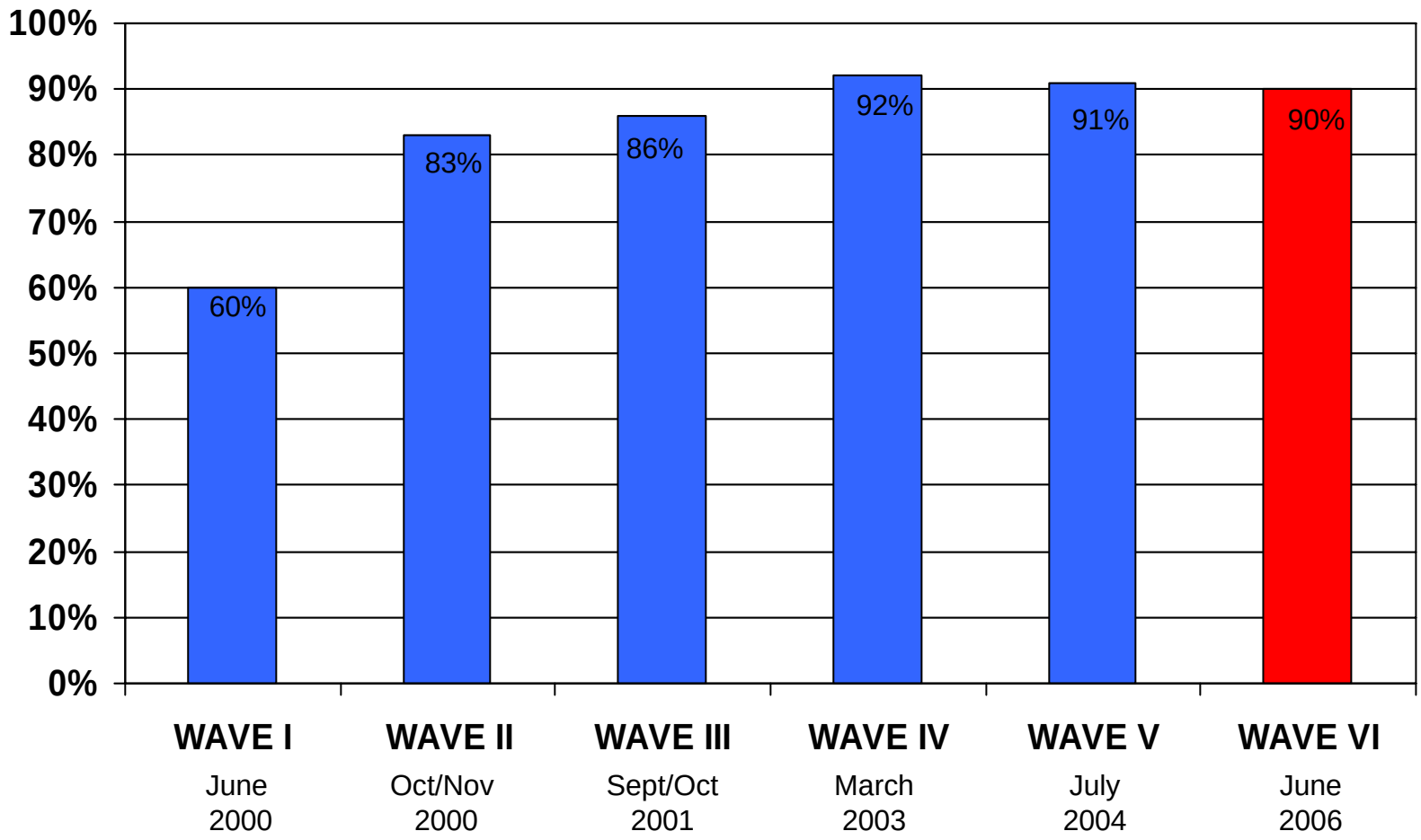
Hardware Continuous Technology Refresh (CTR)

Schedule

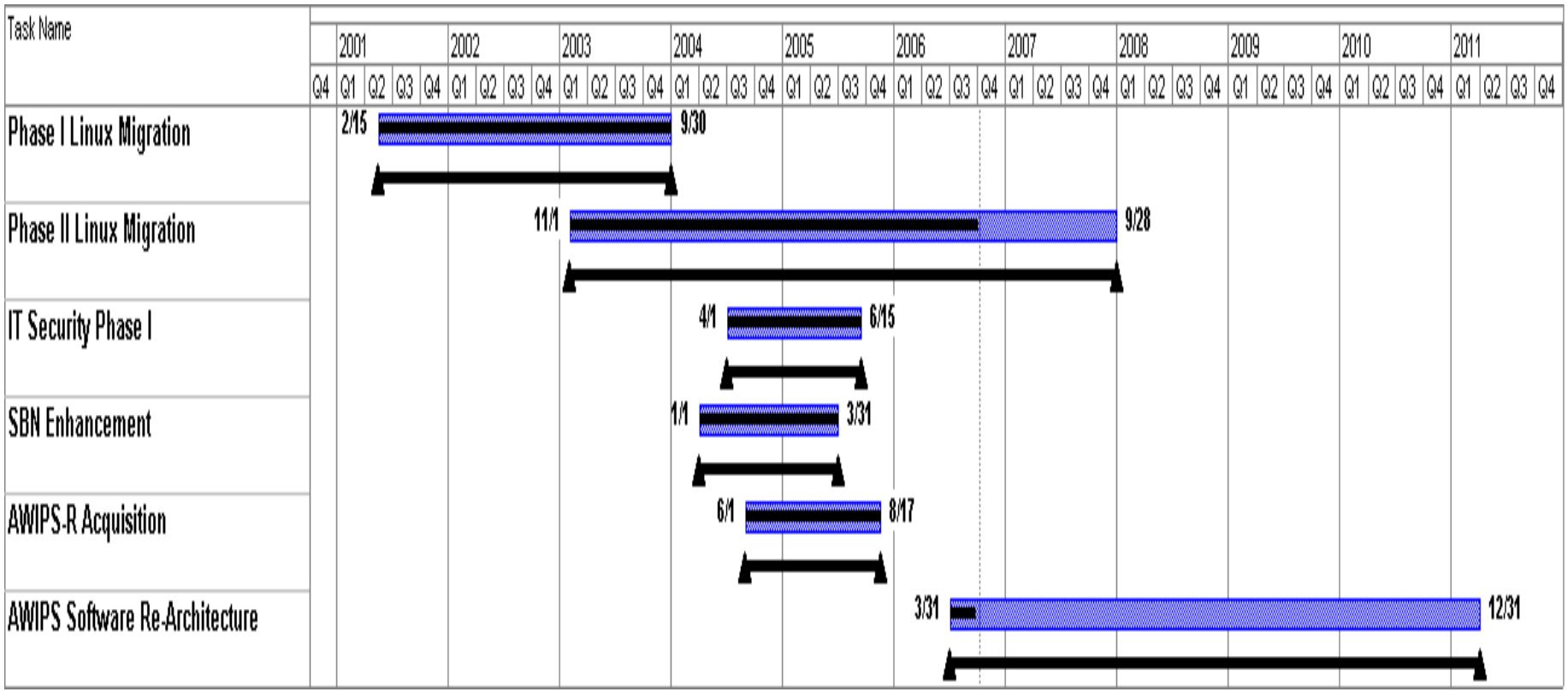
Item	Replaces	CY1*	CY2	CY3	CY4	CY5	CY6	CY7	CY8	CY9	CY10
Comm's Processors	Single 933MHz PIII, 256MB RAM (Rack Mounted)										
Modems	V.34/SDC [42703-3263]										
Modems	Modem, Courier V.Everything Ext 33.6-GFE; 001224-54										
Modems	Modem Backplane; 22374										
Modems	LDAD Fax/Modem; MT2834BA										
Modems	NCF Monitor and Control Modem; 42700										
Modems	Dedicated; 3263 (42603)										
Modems	Enclosure 80400 (w/3262 dual-dial [42602], 3263 dedicated [42603], and V.34/SDC [42703-3263] modems										
Modems	Dual-dial; 3262 (42602)										
Xyplex	MAXserver 40, 4 MB RAM; Maxserver MX-1640-114										
Workstation Replacement	Dual 1.5GHz Xeon, 2GB RAM, 36GB 10Krpm SCSI HD, 2 video cards (1 Matrox g450 and 1 nVidea GeForce2); M-Pro										
Workstation Replacement	19" LCD monitor (qty 3 per workstation); 191N										
Workstation Replacement	Dual 2.4GHz Xeon, 2GB RAM, 36GB 10Krpm SCSI HD, 2 video cards (1 Matrox g450 and 1 nVidea GeForce2); Z-Pro										
Workstation Replacement	19" LCD monitor (qty 3 per workstation); 191N										
LDAD Servers	Single processor w/ 256MB RAM; D270										
LDAD Firewall	Netscreen Model 26										
Routers	2691; IOS ver: c2691-advceurityk9-mz.123-8.T4.bin										
Routers	3725; IOS ver: c3725-advceurityk9-mz.123-8.T4.bin										
Routers	7505; IOS ver: rsp-ik9sv-mz.123-8.T4.bin										
Routers	7507; IOS ver: rsp-ik9sv-mz.123-8.T4.bin										
Pre-Processors (PX's)	Dual 2.4GHz Xeon, 1GB RAM, single 36GB 10K rpm SCSI HD; Poweredge 2650										
X-Terms (Phase 1)	Single 2.8GHz P4, 512MB RAM, 40GB IDE HD, nVidea Quadro NVS280 video card 64MB dual VGA, Dell UltraSharp 1901FP 19" LCD monitor										
X-Terms (Phase 2)	Single 2.8GHz P4, 512MB RAM, 40GB IDE HD, nVidea Quadro NVS280 video card 64MB dual VGA, Dell UltraSharp 1901FP 19" LCD monitor										
DX Replacement	Dual 3.xGHz Xeon, 4GB RAM, 2X73GB 15K rpm SCSI HD; Poweredge 2850										
NAS Replacement	FAS 250, with ten 72GB hard drives, SVC-250-HW-4R-W (3 year, 24x7 Hardware maintenance)										
REP for RFCs (River Ensemble Processor)	Double units, rack mounted with NetApp NAS and Ge switch, two Poweredge 2650 servers										

* "CY" refers to Contract Year

Table 11a.
AWIPS
Performance Ratings
Percentage Indicating "Excellent or Good" Overall



Project Management



Task Baseline Progress

Investment Review Board
AWIPS Product Improvement (API)

BY 2008 IT BUDGET INITIATIVE

GOAL: **Weather & Water**
PROGRAM: **Science and Technology Infusion**
Exhibit 300: **AWIPS Product Improvement (API)**
TYPE OF IT INVESTMENT (DME/SS/Mixed): **SS (as of FY08)**
DESCRIPTION OF IT INVESTMENT: Investment keeps the Advanced Weather Interactive Processing System (AWIPS) hardware, software, and communications technologically current through a program of Continuous Technology Refresh (CTR).

MILESTONES:

- **Completion of Linux Phase I** — **4th Quarter FY03**
- **Completion of Phase II SBN Enhancements** — **2nd Quarter FY05**
- **Completion of AWIPS-R Acquisition** — **August 17, 2005**
- **Completion of Linux Phase II** — **4th Quarter, FY07**

FUNDING

6/22/2006											
AWIPS OY Budget											
									Option Years		
PAC				FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13
Program Mngt.											
Support Contracts				354.4	600.0	621.0	642.7	665.2	688.5	712.6	737.6
Supplies / Training / Travel				145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0
AWIPS, H/W, S/W											
S/W, H/W Licenses				100.0	288.0	288.0	288.0	288.0	288.0	288.0	288.0
Tech Refresh / PI	by project - FFP and/or Cost +										
H/W		@ Kt. Value +		5,653.6	5,665.5	5,471.2	6,762.8	6,299.0	5,699.0	5,244.0	5,834.0
S/W		@ Kt. Value		1,840.0	2,590.0	3,160.0	1,740.0	2,070.0	2,530.0	2,840.0	2,100.0
COMMS		@ Kt. Value		-	310.0	320.0	330.0	340.0	350.0	360.0	370.0
			Sub-total, CTR	7,493.6	8,565.5	8,951.2	8,832.8	8,709.0	8,579.0	8,444.0	8,304.0
S/W Maint. / Spt		Fwd. Fund		2,570.0	for '07						
			Non-Labor	10,663.0	9,598.5	10,005.2	9,908.5	9,807.2	9,700.5	9,589.6	9,474.6
		(esc. @ 4.5%)	Labor	2,016.8	2,065.5	2,158.4	2,255.6	2,357.1	2,463.1	2,574.0	2,689.8
			Sub-Total	12,679.8	11,664.0	12,163.6	12,164.1	12,164.3	12,163.7	12,163.6	12,164.4
TRANSFERS											
Architecture Analysis				300.0	800.0	300.0	300.0	300.0	300.0	300.0	300.0
Base Mitigation				300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
			Sub-Total	600.0	1,100.0	600.0	600.0	600.0	600.0	600.0	600.0
			TOTAL	13,279.8	12,764.0	12,763.6	12,764.1	12,764.3	12,763.7	12,763.6	12,764.4
			PAC FUNDING	'07 PB / '08 NOAA Submit.	12,764	12,764	12,764	12,764	12,764	12,764	12,764
			Non-Labor	10,963	10,399	10,305	10,209	10,107	10,001	9,890	9,775
			Labor	2,317	2,366	2,458	2,556	2,657	2,763	2,874	2,990

BENEFITS

- AWIPS is a critical part of the Nation's infrastructure for sustaining the $4 Trillion weather sensitive economy and for protecting lives and property from severe weather and water events.
- GPRA metrics are sensitive to AWIPS system performance
  - –Tornado Warning Lead Time
  - –Flash Flood Warning Lead Time
- Investments in AWIPS hardware have reduced system delays
- Continuous Technology Refresh (CTR) has proven crucial in keeping AWIPS current
  - –A static system cannot keep up with Science Infusion
  - –More cost effective from a Total Cost of Ownership (TCO) perspective

IT SECURITY & RISKS

- **IT Security**
  - **C&A ID/Approval: NOAA8107/9/29/2005**
  - **C&A Sensitivity Level: High**
  - **IPv6 Status: Routers are compatible**
- **Risks**
  - **Risk Management Plan (RMP) is in place**
  - **Qualitative Risk assessment and prioritization**
  - **Risk Inventory is managed using the Risk Assessment, Management, and Planning (RAMP) tool.**

Architectural Compliance

- ✓ Compliant with Federal Enterprise Architecture (FEA)
  - ✓ Performance Reference Model (PRM)
    - Linkage of “Strategic Outcomes” (Protection of Lives and Property, GPRA) to Process and Technology metrics (WPR, Message Latency)
  - ✓ Business Reference Model (BRM)
  - ✓ Service Component Reference Model (SRM)
    - Good re-use of system components
  - ✓ Technical Reference Model (TRM)
  - ✓ Data Reference Model (DRM)
    - AWIPS is the integration point of most weather/water observations
    - NOAAPort promotes sharing of weather data across Government
- ✓ Support for Government/DOC/NOAA goals
- ✓ Use of Commercial Off the Shelf products
- ✓ Steps taken to address accessibility
- ✓ Information Quality Standard (Section 515)
  - Quality, Objectivity, Utility, Integrity